Following are the Michigan Department of Transportation (MDOT) Research Priorities for Fiscal Year (FY) 2021/2022/2023. The priorities are listed by focus area and grouped according to our Research Advisory Committee (RAC) structure. The transportation research priorities at a national level may also be useful and can be found at:
http://onlinepubs.trb.org/onlinepubs/policystudies/criticalissuesbrochure.pdf

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RAC – Highways Development: Research Manager - Michael Townley

Mission - We will be a knowledge-based, service-oriented organization providing high-quality transportation project development services in support of the department's strategic goals.

Environment and Water Resources – Hal Zweng

Goal 1: Provide easier access to environmental information.

Research Needs:

1. Develop an environmental information management system that provides easy access to information relating to the environmental permit and design phases of project development. Endangered species, wetlands, and archaeological site surveys are examples of the type of available information.
2. Identify invasive species management strategies and mapping locations within the MDOT right-of-way.
3. Identify sensitive water resources and alternative snow/ice management techniques to protect water quality.
4. Investigate strategies for managing contaminated material that is encountered during road construction projects.

Innovative Contracting – Ryan Mitchell/Mark Shulick

Goal 1: Improve the consistency of contracting approaches used for maintenance and operations.

Research Needs:

1. Evaluate current procedures regarding maintenance and operations contracting, and research national/international best practices.
2. Develop a guidebook for standard contracting practices for maintenance and operations. The guidebook will recommend standards for contract language, performance, evaluation and acceptance. Standard payment deductions and incentives for various situations will also be recommended. The documentation developed will be incorporated into the forthcoming update to the "MDOT Innovative Construction Contracting Guide," previously updated 3/5/15.

Goal 2: Improve the consistency of contracting approaches used for Public Private Partnership (P3) projects.

Research Needs:

1. Evaluate current procedures and templates used for P3 contracting, and research national/international best practices.
2. Develop a guidebook for standard contracting practices for P3 project contracting. The guidebook will recommend standard processes for project identification and screening, project development, procurement, implementation and hand back to MDOT, including standards for

contract language, templates, forms and process flowcharts. The documentation developed will be incorporated into the forthcoming update to the "MDOT Innovative Construction Contracting Guide," previously updated 3/5/15.

Goal 3: Improve institutional understanding of innovative contracting program and delivery methods to streamline project development and delivery, reduce risk, and optimize project identification and screening of candidate projects for innovative contract delivery.

Research Needs:

1. Evaluate current MDOT innovative contracting policies, procedures and lessons learned, as well as applicable federal and state law, and existing training presentations produced in-house and by consultant support teams.
2. Develop a single comprehensive, current and consistent innovative contracting training manual, "Innovative Contracting 101" for transportation agency staff. The materials developed will be incorporated into the forthcoming update to the "MDOT Innovative Construction Contracting Guide," previously updated 3/5/15.

Goal 4: Establish innovative contracting project dashboard reporting database to improve internal and external communication, data collection and performance monitoring.

Research Needs:

1. Identify and evaluate legacy project information sources to determine:
   a. accuracy of the data
   b. frequency of the update of the data
   c. format of the data
   d. completeness of the data
2. Establish unified reporting database to include all desired data attributes, and into which legacy system data will be collected on a regular schedule (monthly).
3. Establish uniform report templates in cooperation with bureau and region leadership.

Goal 5: To develop a Michigan Construction Cost Index (CCI) to measure highway construction costs and general monetary inflation costs including materials/labor inflation (similar to the National Highway Construction Cost Index) model (https://www.fhwa.dot.gov/policy/otps/nhcci/).

Research Needs:

1. Research how to use the Fisher Index (consumer price index) to measure the price level of goods over a given period utilizing MDOT historical pricing data.
2. Develop a historical construction cost index annual value back as far as possible trending to the mid-1980s if data is available and formulate a methodology to maintain the construction cost index.
3. Identify best practices to apply the construction cost index to MDOT's future budget needs, cost estimating techniques, project scoping process, and future trend identification.

Goal 6: To develop a goal for MDOT to incorporate Performance Based Practical Design (PBPD) methodology into projects.

Research Needs:

1. Research how MDOT can utilize PBPD on a system and corridor approach.

2. What tools and models can be utilized to make recommendations for PBPD?
3. How will PBPD be evaluated for performance when incorporated into projects?
4. Determine what the systematic benefits of PBPD will be when incorporated into projects.

Real Estate and Permits – Larry Doyle

Mission - The Development Services Division provides the highest quality services in real estate, permits, utility coordination, agreements, and local agency programs for all areas of MDOT.

Goal: Develop tools and identify resources to create accessible and useful real estate and permit information.

Research Needs:

1. Make public parcel data that is collected and overseen by individual municipalities more publicly accessible and useful across the state. The Department of Technology, Management and Budget has a program to collaborate and share LiDAR and aerial imagery to locals in exchange for them providing parcel information. It would be good to fund research on how to expand this program as this information is very useful to MDOT.
2. Develop a risk-based tool that assists in determining if identified right-of-way (ROW) can be classified as excess and sold to private entities.
3. Identify the legal barriers, technology trends, and benefit/cost to developing and implementing new tools that support digital access to MDOT ROW information, trucking permits, ROW permits and driveway permits.

Rest Areas, Utilities and Landscaping – Bill Stonebrook

Goal: Develop metrics, materials, and specifications to improve element performance within various contexts.

Research Need:

1. Develop metrics for complete streets and context sensitive solutions including seeking stakeholder input.

Surveys and Automated Design – Dan Belcher

Goal: Proper translation of survey and design data from design to construction to operations/ maintenance.

Research Needs:

1. How to translate a 3D model to individual assets for construction (MDOT and Contractor) inspection and installation activities.
2. How to capture As-Built asset information during inspection activities and add the necessary asset attributes.
3. How to convert construction assets to the Enterprise Asset Management System for use in operations and maintenance.

RAC – Highways, Bridges and Structures: Research Manager - Michael Townley

Mission - We are devoted to the efficient and innovative design, construction, and active preservation of transportation structural assets, inspired by safety, resiliency, and mobility.

Bridge and Structure Design and Construction – Brad Wagner and Bridge and Structure Maintenance and Preservation – Jason DeRuyver

Goal 1: Develop a better understanding of how to manage key structural assets.

Research Needs:

1. Bridge beam end deterioration monitoring and analysis is an important topic with the need to understand the timing of repairs, appropriate repairs, and capacity of the structure at various states of repair.
2. MDOT has focused research on retaining wall asset management in recent years, however there are several other ancillary structures in the ROW that are of importance that could benefit from inventory and analyses standards to improve asset management.
3. Deck overlays are completed to preserve a structure and these repairs have an impact on the capacity of a structure. Understanding the performance of the Michigan specific overlay repair, its long term debonding and integral performance and the life cycle performance are of interest.
4. There are roughly 500 to 600 local agency bridges with facia beams that have significant deterioration, while the inside beams are not experiencing significant deterioration. Understanding the point that these beams need to be replaced and techniques for replacing the beams when they have been built as side by side post tensioning.
5. Hold a technology transfer seminar for management of ancillary structures or moveable bridge operations, incident management and asset management (include local agencies, first responders, and engineers). The seminar could invite national experts to help transfer new technologies to MDOT.
6. Mechanically stabilized earth wall maintenance and repair.
7. Asset management of movable bridges.
    a. Expected service life of electrical/mechanical components. Best practices for rehabilitation/replacements of these components and cyclical maintenance activities.
    b. Analysis of different operating systems. (life cycle cost analysis, reliability of relays, programmable logic controllers, electrical, hydraulics).
    c. Best practices for troubleshooting malfunctions (i.e., labeling wires)
    d. Reuse of old substructures, addressing scour criticality.
    e. Detour routes are often very long (or nonexistent - Houghton). Best practices for operations when a bridge malfunctions. Communication plan, emergency services, identified routes, etc.

Goal 2: Development of New Technology and Modernization of MDOT's Bridge Program.

Research Needs:

1. A nonproprietary Ultra High-Performance Concrete (UHPC) has been developed and applied in Michigan. A comparison analysis for the branded UHPC and the nonproprietary UHPC could be completed to better understand when to apply each in competitive bid projects. Additionally, bridge elements beyond closure joint that these products could be used in could be explored.
2. Recent advances in technology make it much less expensive to monitor water levels at scour critical bridges as part of their scour critical plan. Developing a network of gauges on critical bridges could improve response time during flood events.

Geotechnical and Foundational Design – Dick Endres

Goal 1: Structural Health: Screen bridge population for structures with steel foundation piles and determine the remaining (theoretical) design life for the piles.

Research Needs:

1. Determine corrosion rates for various pile sections and corrosion environments.
2. Develop risk management strategy to flag and inspect structures. Develop prioritized "threat" list based on risk factors such as age, pile type, most aggressive corrosion environment, least redundancy, highest average daily traffic, etc.

RAC – Highways Delivery and Operations: Research Manager - Andre Clover

Mission - We provide leading edge services and solutions.

Construction – Matt Bellgowan

No Research Priorities

Intelligent Transportation Systems and Signals – Collin Castle

No Research Priorities

Fleet/Facility Management and Operations – Sonja Scheurer

Goal 1: Improve/increase lifespan of MDOT facilities.

Research Needs:

1. Quantify the life cycle cost of available roofing materials and roof types to improve the cost effectiveness of roofing systems.
2. Quantify the life cycle cost of available interior building materials to improve the cost effectiveness of interior building construction and maintenance.

Roadway and Roadside Maintenance – Tim Croze

Goal 1: Leverage data from existing MDOT systems and/or programs that are applicable to maintenance operations to improve operations, increase effectiveness, develop performance metrics, etc.

Research Needs:

1. Leverage data from these programs to create opportunities for incorporating into a needs-based budgeting process
2. Use a winter severity index to create a comparison of winter maintenance expenses, material usage, etc.
3. Provide ideas on decision support tools that could be created for maintenance utilizing existing data sources.

Goal 2: Document, evaluate, and communicate maintenance best practices and emerging technologies

Research Needs:

1. Evaluate maintenance practices and identify those practices that should be communicated across the state.
2. Evaluate emerging technologies.

Mobility and Traffic Incidents – Steve Cook

No Research Priorities

Pavements and Materials – Curtis Bleech and John Staton

Goal 1: Increase the overall performance of MDOT's various pavement fixes.

Research Needs:

1. Continue to calibrate and improve the accuracy of Mechanistic-Empirical Pavement Design Guide performance models relative to Michigan pavement performance.
2. Evaluate the various methods that are available for pavement performance modeling and compare to MDOTs methodology.
3. Evaluate the advantages/disadvantages of crushed concrete as an open-graded aggregate.
4. Evaluate the impact of available concrete additives on concrete permeability.
5. Identify minimum pavement base/subbase thicknesses necessary to provide adequate frost-heave protection to the pavement structure.
6. Compare the performance of pavement structures utilizing the "Metro 16-inch aggregate on 8-inch sand" base design versus the more typical "Out state 6-inch aggregate base over 18-inch subbase design."
7. Evaluate the impact of super-single (wide base) tires on pavement performance.
8. Improve performance testing/balanced mix designs for hot mix asphalt pavements. Synthesis of current and past research on performance and economic impacts of truck gross weights, overweight trucks, and permitted super loads on pavement.
9. Evaluate the advantages/disadvantages of requiring subgrade stabilization and the impacts on long term pavement performance.
10. Evaluate the performance of jointed plain concrete pavement as it relates to the Michigan Truck Gross Vehicle Weight/Axle Configuration versus current transverse joint spacing.

Transportation Safety – Mark Bott

Goal 1: Continue to progress toward zero highway deaths by further preventing or reducing the severity of crashes through the implementation of cost-effective crash reduction strategies.

Research Needs:

1. Identify new crash countermeasures/infrastructure improvements that leverage emerging transportation technologies related to vehicle to vehicle communication and vehicle to infrastructure communication.
2. Review safety related best practices, resulting from past research, and recommend implementation, training and communication strategies.
3. Develop tools that assist in balancing competing priorities and quantify safety impacts in the annual call for projects.
4. Study the safety related impacts of past speed limit increases on Michigan State Trunk lines.
5. Develop and recommend statewide/regional safety strategies which can be implemented by MDOT in support of Toward Zero Deaths.

Worker/Facility Safety and Security Emergency Management – Eileen Phifer

Goal 1: Evaluating the effectiveness and cost-benefit ratio of emergency management features.

Research Needs:

1. Evaluating the effectiveness and cost-benefit ratio of permanent emergency route signing.

2. Evaluating the effectiveness and cost-benefit ratio of betterment features in lieu of replacement in kind.

RAC – Multi-Modal Transportation: Research Manager – Mary Hoffmeyer

Aviation – Bryan Budds

Mission - Develop and preserve a safe, high-quality state-wide air transportation system.

No Research Priorities

Freight Logistics and Maritime – Larry Karnes

No Research Priorities

Freight Rail – Nikkie Johnson

Goal 1: Initiate investment that improve economic development

Research Needs:

1. Identify and/or develop calculations that can quantify the impact of rail investments on economic growth.
2. Identify and/or develop calculations that can compare the benefits of multiple transportation modes on economic growth.

Intercity Bus – Rob Pearson

Mission - Providing Michigan Citizens with The Best Passenger Transportation Services Through Quality Customer Assistance - We Move People

No Research Priorities

Local Transit – Dean Peterson

Mission - Providing Michigan Citizens with The Best Passenger Transportation Services Through Quality Customer Assistance - We Move People

Goal 1: Preparing for the Future of Ferry Service

Research Needs:

1. Determine what are the state and federal responsibilities to address the transportation implications, be it economic (tourism, logging) or quality of life (emergency services, food, transportation to work) of choosing to live on an island (Beaver, Drummond, Neebish or Sugar Islands).

Goal 2: Preparing for the Future of Public Transportation

Research Needs:

1. Determine how technological changes have evolved the way transit is implemented as a service and determine the state's role in mobility as a service and mobility on demand, considering all of the services that encompasses (i.e., cell phones, computerized mapping and scheduling, google, social platforms).

2. Develop strategies for future local and long-distance passenger transportation systems that account for changing demographics, changing customer needs/preferences, emerging vehicle technologies including automated vehicles, emerging private sector passenger transportation services (Uber, Lyft, etc.) and shared use mobility services.
3. Develop future federal and state funding strategies, related to technical assistance and regulatory programs, that will account for future passenger transportation changes.

Passenger Rail - Jeff Martin

Goal 1: Improve Intercity Passenger Rail performance.

Research Needs:

1. Determine the effects of on-time performance on ridership and revenue.

Private/For Hire Passenger Carriers - Rob Pearson

Mission - Providing Michigan Citizens with The Best Passenger Transportation Services Through Quality Customer Assistance - We Move People

No Research Priorities

RAC – Planning, Finance and Organizational Development: Research Manager – Mary Hoffmeyer

Roadway Asset Management – Wendi Burton

No Research Priorities

Contract Administration – Carol Rademacher

Mission - To provide the highest quality contract, records and forms services to our customers in support of MDOT's mission.

No Research Priorities

Finance – Adam Feldpausch

Mission - To provide quality financial and administrative services to optimize the accomplishment of MDOT's mission.

No Research Priorities

Non-Motorized Planning and Development – Deb Alfonso

Goal 1: Improve Safety and Access to Nonmotorized Facilities

Research Needs:

1. Develop scoping and design guidance to improve direct access to nonmotorized facilities. Review and recommend signing techniques, signal crossing technologies and improved visibility strategies to improve facility access and safety.

2. Identify strategies that enhance connectivity of nonmotorized facilities to transit, rail, aviation, and highway facilities.
3. Investigate methods, practices, and feasibility of using crowd-sourced data (public and/or private) for assessing ped/bike volumes, routes, etc. for various analysis purposes.

Program Development – Denise Jones

No Priorities

Transportation Policy – Craig Newell

No Priorities

Travel Demand Processing – Karen Faussett

No Priorities

Work Force Development – Christine Hunnicutt

Mission - In partnership with MDOT leadership, improve organizational, group and individual performance.

Goal 1: Recruit high quality employees

Research Needs:

1. Identify recruitment best practices (public and private sector) including funding strategies and recruitment initiatives.
2. Research how other DOTs determine classification and pay scale for hard-to-fill, hard-to-keep positions/fields.
3. Identify Civil Service job specifications with limited degree qualifications, for possible inclusion of additional fields of studies. Identify have/how other DOTs determine degree qualifications for these fields.

Goal 2: Retain and develop a high performing workforce

Research Needs:

1. Identify a workforce development strategy that includes all facets of learning such as: traditional training courses, job shadowing, mentorship, etc. This strategy will include skill development opportunities in technical areas, communication, interpersonal and emotional intelligence.
2. Identify strategies that will assist MDOT leadership in encouraging buy-in to workforce and organizational development across the department. Recommend strategies that will foster employee engagement, participation and buy-in.

Goal 3: Prepare and inspire employees to assume future leadership roles.

Research Needs:

1. Identify tools, approaches, and best practices that will cultivate aspiring employees for future leadership roles.